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STAIR CLIMBING ROBOT

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ABSTRACT
The advent of new high-speed technology and the growing computer Capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices, new drivers and advanced control algorithms. This project describes a new economical solution of robot control systems. The main objective of this present work is to build a robot machine which is capable of climbing stairs using PC based zigbee wireless communication network. The structure of the robot is based on the Tri-wheel configuration which refers to a system of three wheels sandwiched between two Y-frames. This mechanism supports for two kinds of motion of the wheels of the tri-wheel system – first, about the axis through the centre of each of the wheels and second, the rotator motion about the axis of the tri-wheel Spur gear mechanism itself. This flexibility empowers for the transporter to climb steps easily. The presented robot control system can be used for different security, military based war robotic applications for climbing stairs. The presented robot control system can be used for different sophisticated robotic applications.

Keywords: ***Tri-wheel Spur gear mechanism robot, Zigbeetransceivers, DC motors.***

1. INTRODUCTION

Today, due to technological advances of robotic applications in human life, it is necessary to overcome natural and virtual obstacles such as stairs which are the most known obstacles to the motion of such robots. Several researches have been conducted toward the design of stair climbing and obstacle traversing robots during the past decade. A number of robots have robots have been built for climbing stairs and traversing obstacles, such as quadruped and hexapod robots. Although these robots can climb stairs and traverse obstacles, they do not have smooth motion on flat surfaces, which is due to the motion of their legs. Buehler built a hexapod robot (RHex) that could ascend and descend stairs dynamically. There is an enormous variety of walking robots in the world today. Most of them have six legs to maintain good static stability, many have 8 legs for greater speed and higher load capacity and there are some that implement clever balancing algorithms which allow them to walk on two legs to move over sloping ground and to climb up and down stairs, like humans do (eg.Such as Honda's Asimo robots). Rough-terrain robot navigation has received a significant amount of attention recently, most prominently showcased to the broader public by the success of current Mars rover missions. In the future, increased autonomous capabilities will be required to accomplish ambitious planetary missions as well as a whole variety of Earth-bound tasks. This demand has led to the development of numerous approaches to solving the rough-terrain robot motion planning task. The common factor with all such research lies in the underlying characteristics of the rough terrain itself by the very nature of the task, binary obstacle definitions cannot be exclusively applied to roughterrain motion planning. Each configuration of the robot operating on the terrain has a characteristic difficulty associated with its attainment. Depending on the properties of the problem being studied, different aspects of the robot/terrain interaction assume high relevance. These factors are consequently included in the terrain abstraction while other aspects are typically chosen to be omitted.

Military robots are autonomous robots or remote-controlled devices designed for military application currently being researched by a number of militaries. Robot builders may be of any age and come from any walk of life There are three types of moving mechanisms for this kind of robots in general: wheel type, track type and walking type mechanism. Robots with wheel mechanism are inferior to robots with track when they are to move on rough terrain. Walking robots have complex structures so that they are usually difficult to control and slower in speed

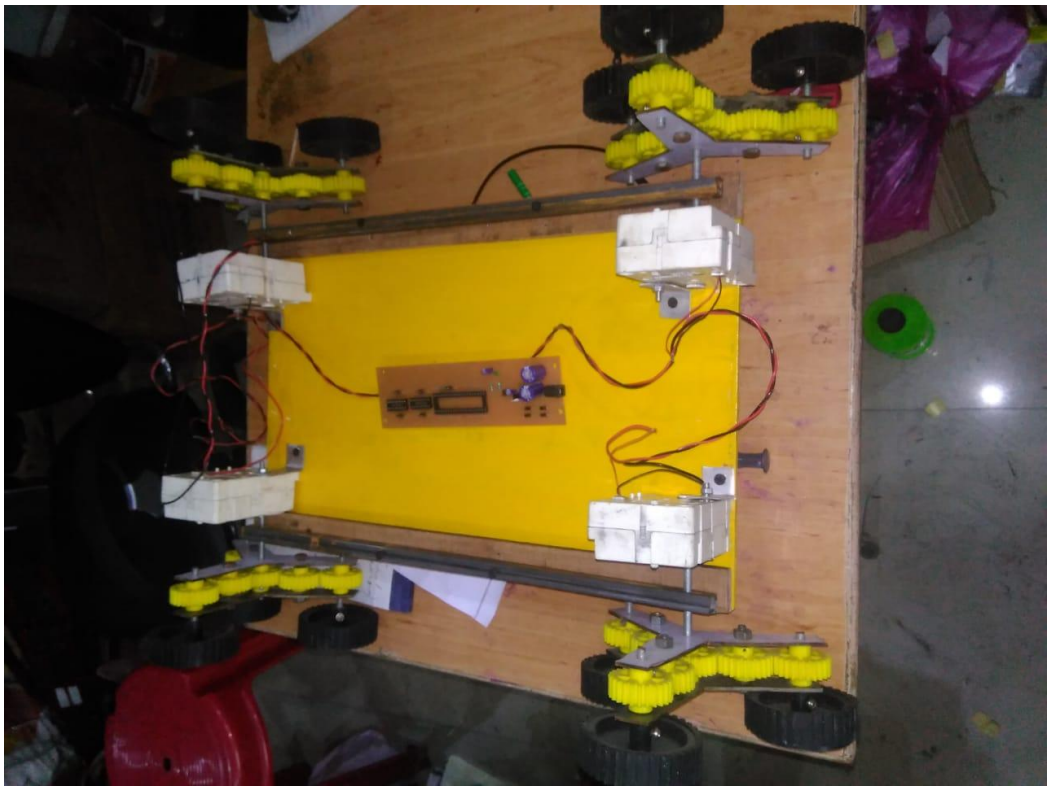

Fig-1: Model of All terrain stairs climbing robot

RELATED WORK

The objective of the proposed system is to design an all terrain stairs climbing robot with Zigbee modules for establishing wireless communication between PC and Robot which is capable of climbing the stairs. The DC motors is attached to the robot for the movement of the robot and PIC microcontroller which performs the controlling operations of Robot in climbing the stairs. Four main principles - rolling,walking, crawling and jumping - have been identified for full or partial solid state contact. However, additional locomotion principles without solid state contact could be of interest in special environment. Most of the mobile robots for planetary exploration will move most of their time on early flat surfaces, where rolling motion has its highest efficiency and performance. However, some primitive climbing abilities are required in many cases. Therefore hybrid approaches, where for example rolling motion is combined with stepping, are of high interest The **tri-star** is a novel wheel design originally by Robert and John Forsyth, assignors to Lockheed in 1967 in which three wheels are arranged in an upright triangle with two on the ground and one above them. If either of the wheels in contact with the ground gets stuck, the whole system rotates over the obstruction.

Working of the geared dc motor

The geared dc motor as shown in Fig. 2 is works over a fair range of voltage. The higher the input voltage more is the rpm (rotations per minute) of the motor. For example, if the motor works in the range of 6-12V, it will have the least rpm at 6V and maximum at 12 V.

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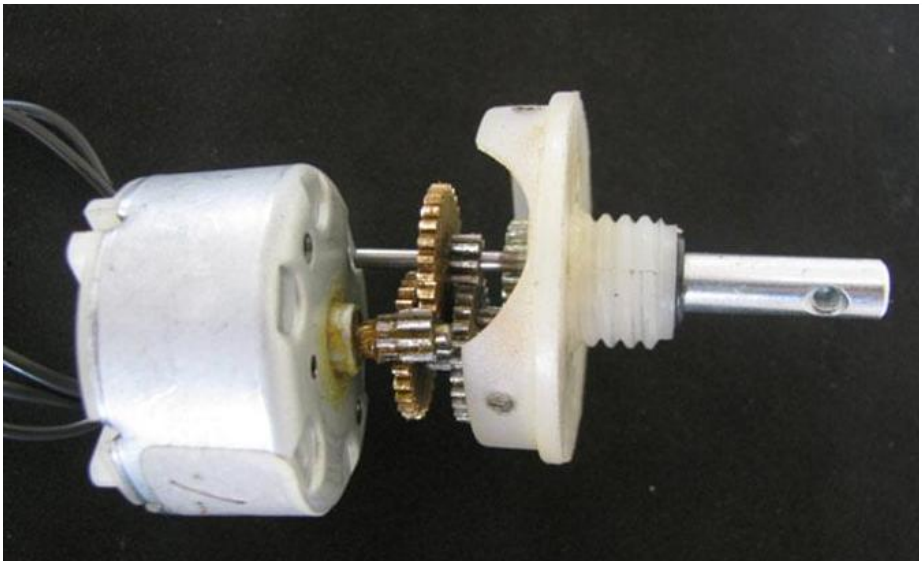

Fig. 2 geared dc motor

The working of the gears is very interesting to know. It can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more rpm than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio. When multiple gears are connected, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it. In any dc motor, rpm and torque are inversely proportional. Hence the gear having more torque will provide a lesser rpm and converse. In a geared dc motor, the concept of pulse width modulation is applied. In a geared dc motor, the gear connecting the motor and the gear head is quite small, hence it transfers more speed to the larger teeth part of the gear head and makes it rotate. The larger part of the gear further turns the smaller duplex part. The small duplex part receives the torque but not the speed from its predecessor which it transfers to larger part of other gear and so on. The third gear's duplex part has more teeth than others and hence it transfers more torque to the gear that is connected to the shaft.

Fig-3: Tri Star wheel model of stairs climbing robot

Advantages of Tristar Wheel

- The control system is simple and the robot is controlled remotely.
- Mechanism is simple comparing to other available designs and it is easy to assemble and disassemble when necessary.
- Use of Castermid as the material for gears makes them light and no lubrication is required during movement.
- Using the worm gearbox makes robot's travel safe. If by any chance voltage is cut off or batteries ran out of charge the robot will stay in its position.
- The cost is reasonable compare to other available designs.
- The net weight of the robot compare to its size is reasonable.
- The possibility of malfunction is almost zero, since there is no complex assembly or mechanism.

Tri Star Wheel Works Based On Spur Gear Mechanism

Spur gears or straight-cut gears are the simplest type of gear. It consists of a cylinder or disk with the teeth projecting radially, and although they are not straight-sided in form of the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears can be meshed together correctly only if they are fitted to parallel shafts.

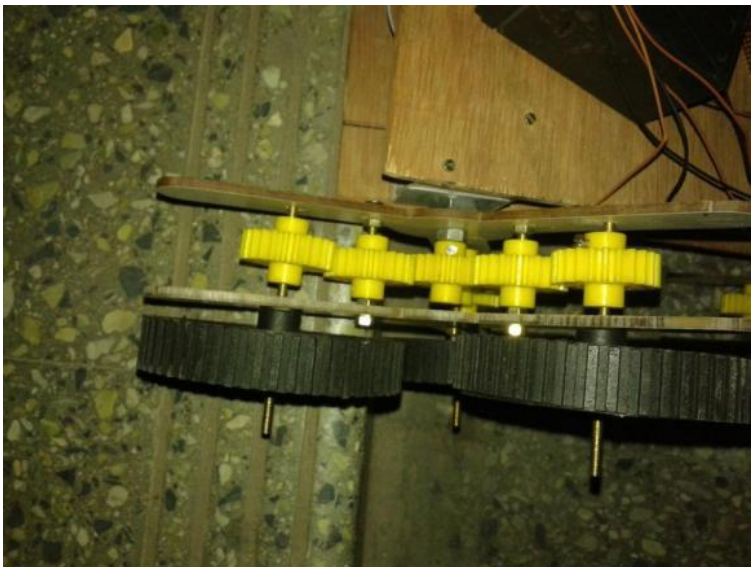

Fig-4: Spur gear mechanism of stairs climbing robot

The Spur Gear Design Mechanical engineers working in transmission field would often have to decide upon kind of gears for usage. A designed gear criteria conforming to AGMA standards should have the following:

1. Enough mechanical strength to withstand force transmitted
2. Enough surface resistance to overcome pitting failure
3. Enough dynamic resistance to carry fluctuating loads

The designing Features:

1. Required monitoring of amount of power to be transmitted, pinion, speed, gear ratio, life of gear drive and other working conditions.
2. Based on the transmitting power and gear ratio, select a suitable material. Usually the pinion is subjected to more loading cycles then gear and hence the material selected for pinion should be strong than gear material

HARDWARE DESIGN OF PROPOSED SYSTEM

In this paper we presented a PC based wireless stair climbing robot which is capable of climbing all terrains stairs in its path and which is wirelessly controlled through PC using Zigbee technology. The controlling device of the whole system is a MICROCONTROLLER to which Zigbee module; DC motors of robot are interfaced through a motor driver. Whenever the appropriate keys are pressed in the keyboard of computer, the data related to those keys will be transmitted over Zigbee module using RS232 cable. This data will be received by Zigbee

module at robot and this data is fed as input to the controller. The controlling device of the whole system is a Microcontroller. Whenever the user presses any key from keyboard of the PC, the data related to that key is sent through Zigbee module interfaced to PC. Whenever the appropriate keys are pressed in the keyboard of computer, the data related to those keys will be transmitted over Zigbee module. This data will be received by Zigbee module at robot and this data is fed as input to the controller. The Microcontroller checks the data with the program embedded in it and performs appropriate actions on the DC motors of the stair climbing robot. This data will be received by the Zigbee module in the robot system and feds this to Microcontroller which judges the relevant task to the information received and acts accordingly. The Microcontrollers used in the project are programmed using Embedded C language.

Battery

The batteries in which a reversible reaction is responsible for the generation of electricity such that they can be reverted to the original reactant state fall under the category of secondary batteries. Recharging is effected by passing electric current through the battery. The oldest form of rechargeable battery is the Lead-Acid battery. Lead Acid battery market is dominating primarily because of the unavailability of any able competitive solution in the market and that they offer lowest cost per watt-hour despite of their low specific energy. The desire to make these batteries maintenance free, the flooded battery type evolved into two variants: Sealed Lead Acid or Gel cells and valve regulated lead acid (VRLA) Batteries. The flooded battery types are still seen in automobiles ups etc. But due to this evolution, the lead acid batteries now cannot charge to their true potential where gassing and water depletion in the acid may take place. Further, these must be stored in fully charged state or else salvation may cause the degradation of the battery performance. The amount of electric power that can be delivered is often a function of amount of lead present. Here we use lead acid battery as shown in Fig. 5.

Fig. 5 lead acid battery

RESULT

In the robot we use motors and gearbox that the robot capable to run the robot at the speed of 0.314m/s. This robot is capable to climb the steps of height of 150mm and length of 370mm as per consider while designing. The robot gets the stability because of the center of gravity of the model is close to be stair

CONCLUSION

An existing All terrain climbing robot system ―Advanced wireless controlled Stair Climbing Robot‖ was designed such that the robot can be operated using PC which is capable of climbing stairs based on Tri-wheel configuration patented. The controlling device of the whole system is a Microcontroller. Whenever the user presses a button in the PC, the data related to that button is sent through Zigbee module interfaced to PC. Whenever the appropriate keys are pressed in the keyboard of computer, the data related to those keys will be transmitted over Zigbee module. This data will be received by Zigbee module at robot arm and this data is fed as input to the controller. The Microcontroller checks the data with the program embedded in it and performs appropriate actions on the robot.

The robot can also be extended by connecting wireless camera to the robot, then we can view the outer world from our personal computer only by using GPRS and GPS. We can use this robot at so many fields and we can use to handle so many By connecting bomb detector to the robot, we can send it to anywhere i.e (battle field, forests, coal mines, to anyplace) by using our personal computer and we can able to detect the bomb at field, here sensor detects the bomb and gives information to micro controller and it gives the information to transceiver and it sends the information to the personal computer. It can also be extended by connecting temperature, gas, smoke sensors to the robot we can get the temperature, leakage of any gases, smoke of dangerous zones as it can climb all terrains, hilly and rocky regions also in personal computer itself instead of sending human to there and facing problems at field we can send robot to there and sensor will detect the environmental condition and it gives information to the micro controller and micro controller gives the information to the transceiver from that we can get the data at pc side

FUTURE SCOPE

The features of the robot can be enhanced by improving its architecture such as:
1. Using motors with higher torque and still well de-signed wheels to improvemovement.
2. Mounting mechanical arm for applications such as pick and place, bomb disposal, rescue robot, etc

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